SCIENCE AND RELIGION.

FULL TEXT OF PROF. TYNDALL'S ADDRESS BEFORE THE BRITISH ASSOCIATION, A PHILOSOPHICAL HISTORY OF SCIENCE ECCLESIAS-

TICAL MODES OF THOUGHT INTERFERING WITH PROGRESS - IMAGINARY DISCUSSION BETWEEN LUCRETIUS AND BISHOP BUTLER-TYNDALL'S ES-TIMATE OF DARWIN AND SPENCER-THE PRESENT POSITION OF SCIENCE.

An impulse inherent in primeval man turned his thoughts and questionings betimes toward the sources of natural phenomena. The same impulse, inherited and intensified, is the spur of scientific action to-day. Determined by it, by a process of abstraction from experiwe orm physical theories which lie beyond the pale of experience, but which satisfy the desire of the mind to see every natural occurrence resting upon a cause. In forming their notions of the origin of things, our earliest historic cand, doubtless, we might add, our prehistoric) ancestors pursued, as far as their intelligence permitted, the same course. They also fell back upon experience, but with this difference—that the particular experiences which furnished the weft and woof of their theories were drawn, not from the study of nature, but from what lay much closer to them, the observation of men. Their theories accordingly took an anthropomorphic form. To supersensual beings, which, however potent and invisible, were nothing but species of human creatures, perhaps raised from among mankind, and retaining all human passions and appetites," were handed over the rule and governance of natural phenomena. Tested by observation and reflection, these early notions failed in the long run to satisfy the more penetrating intellects of our race. Far in the depths of history we find men of exceptional power differentiating themselves from the crowd, rejecting these anthrepomorphic notions, and seeking to connect natural phenomena with their physical principles.

THE BIRTH OF SCIENCE. But long prior to these purer efforts of the under-standing the merchant had been abroad, and rendered the philosopher possible; commerce had been develeped, wealth amassed, leisure for travel and for speculation secured, while races educated under different conditions, and therefore differently informed and endowed, had been stimulated and sharpened by mutual contact. In those regions where the commercial arissecracy of ascient Greece mingled with its Eastern neignbors, the sciences were born, being nurtured and developed by free-thinking and courageous men. The state of things to be displaced may be gathered from a passage of Euripides quoted by Hume. "There is nothing in the world; no glory, no prosperity. The gods toss all into confusion, mix everything with its reverse, that all of us, from our ignorance and uncertainty, may pay them the more worship and reverence." Now, as science demands the radical extirpation of caprice and the absolute reliance upon law in nature, there grew with the growth of scientific notions a desire and determination to sweep from the field of theory this mob of gods and demons, and to place natural phenomena on a basis more congruent with them seives. The problem which had been previously approached from above was now attacked from below; theoretic effort passed from the super to the sub-It was felt that to construct the universe in iden it was necessary to have some notion of its cor stituent paris-of what Lucrotius subsequently called the "First Reginnings." Abstracting again from experience, the leaders of scientific speculation reached at length the pregnant doctrine of atoms and molecules, the latest developments of which were set forth with such power and clearness at the last meeting of the British Association

THE PHILOSOPHY OF DEMOCRITUS.

Thought no doubt had long hovered about this doctrine before it attained the precision and completeness which it assumed in the mind of Democritus, a philos opher who may well for a moment arrest our attention. "Few great men," says Lange, in his excellent History of Materialism, a work to the spirit and letter of which I am equally indebted, "have been so despitefully used by history as Democritus. In the distorted images sent down to us through unscientific traditions there remains of him almost nothing but the name of 'the laughing philos opher,' white figures of immeasurably smaller significance spread themseives at full length before us." Lange speaks of Bacon's high appreciation of Democritus-for ample illustrations of which I am indebted to my excellent friend Mr. Spedding, the learned editor and mographer of Bacon. It is evident indeed that Bacon considered Democritus to be a man of weightier metal than either Plate or Aristotle, though their phiiosophy " was noised and celebrated in the schools, amid the din and pomp of professors." It was not they but Genseric and Attila and the barbarians, who destroyed the atomic philosophy. "For, at a time when all human learning had suffered shipwreck, these planks of Aristotellau and Platonic philosophy, as being of a lighter and more inflated substance, were pre-served and came down to us, while things more solid sank and almost passed into ophvion. The principles enunciated by Democritus reduced the phenomena of nature from the caprices of the gods. They are briefly these; 1. From nothing comes nothing. Nothing that exists can be destroyed. All changes are due to the combination and separation of molecules. 2. Nothing happens by chance. Every oc currence has its cause, from which it follows by necessity. 3. The only existing things are the atoms and empty space; all else is mere opinion. 4. The atoms are infinite in number, and infinitely various in form: they strike tegether, and the lateral motions and whirlings which thus arise are the beginnings of worlds. 5. The varieties of all things depend upon the varieties of their atoms, in number, size, and aggregation. 6. The soul consists of free, smooth, round atoms, like those of fire. These are the most mobile of all. They interpenetrate the whole body, and in their motions the phenomena of life arise Thus the atoms of Democritus are individually without sensation; they combine in obedience to mechanical laws; and not only organic forms, but the phenomena of sensa tion and thought are also the result of their combination THE EPICUREAN PHILOSOPPLY.

That great enigma, "the exquisite adaptation of one part of an organism to another part, and to the conditions of life," more especially the construction of the human body. Democritus made no attempt to solve. Empedocies, a man of more flery and poetle nature, in troduced the notion of leve and hate among the atoms to account for their combination and separation. No ticing this gap in the doctrine of Democritus, he struck in with the penetrating thought, linked, however, with some wild speculation, that it lay in the very nature of those combinations which were suited to their ends (in other words, in harmony with their environment) maintain to themselves, while unfit combinations having no proper habitat, must rapidly disappear. Thus, more than 2,000 years ago, the doctrine of the "survival of the fittest," which in our day, not on the basis of vague conjecture, but of positive knowledge, has been raised to such extraordinary significance, had received at all events partial enunciation. f Epicarus, said to be the son of a poor schoolmaster at Samos, is said to be the next dominant aligure in the atomic philosophy. He mastered the writings of Democritus. heard lectures in Athens, returned to Samos, and subsequently wandered through various countries He finally returned to Athens, where he bought a garden, and surrounded henself by pupils, in midst of whom he lived a pure and serene life, and died a peaceful death. His philosophy was almost identical with that of Democritus; but he never quoted either friend or foe. One main object of Epicurus was to free the world from superstition and the fear of death. Death he treated with indifference. It merely robs us of sensation. As long as we are, death is not: and when death is, we are not. Life has no more evil for him who has made up his mind that it is no evil not to live. He adored the gods, but not in the bion. The idea of divine power, properly purified, he thought an elevating one. Still he taught, "Not he is godiess who rejects the gods of the crowd, but rather he who accepts them." The gods were to him eternal and immortal beings, whose blessedness excluded every thought of care or occupation of any kind. Nature pursues her course in accordance with everlasting laws, the gods never interfering." They haunt

The incid interspace of world and world Where never creeps a cloud or moves a wind, Nor ever falls the least write star of snow, Nor ever lowest roll of thunder means,

Lange considers the relation of Epicurus to the gods subjective "-the indication, probably, of an ethical requirement of his own nature. We cannot read history with open eyes, or study human nature to its depths and fall to discern such a requirement. Man has never been, and he never will be, satisfied with the operation and products of the understanding falone; hence physical science cannot cover all the demands of nature. But the history of the efforts made to satisfy these demands might be broadly described as an history of errors—the error consisting in ascribing fixity to that which is fluent, which varies as we vary, being gross

when we are gross, and becoming, as our capacities wid a, more abstract and sublime. On one great point one mind of Epicurus was at peace. He neither sought nor expected, here or hereafter, any personal profit, from his relation to the gods. And it is assuredly a fact that loftiness and serenity of thought may be prom by concepcions which involve no idea of profit of this kind. "Did I not believe," said a great man to me once, "that an intelligence is at the heart of things, my life on earth would be intolerable." The utterer of these words is not, in my opinion, rendered less noble, but more noble, by the fact that it was the need of ethical barmony here, and not the thought of personal profit hereafter, that prompted his observation.

THE THEORIES OF LUCRETIUS. A century and a half after the death of Epicurus, Lucretius wrote his great poem, " On the Nature of Things, in which he, a Roman developed with extraordinary arder the philosophy of his Greek predecessor. He wishes to win over his friend Memmius to the school of Epicurus; and although he has no rewards in a future life to offer, although his object appears to be purely negative, he addresses his friend with the heat of an aposile. His object, like that of his great forerunner, is the destruction of superstition; and considering that men trembled before every natural event as a direct monition from the gods, and that everlassing torture was also in prospect, the freedom aimed at by Lucretius might perhaps be deemed a positive good. "This terror," he says, "and darkness of mind, must be dispeiled, not by the rays of the sun and glittering shafts of day, but by the aspect and the law of nature." He refuces the notion that anything can come out of nothing, or that that which is once begotten can be recalled to nothing. The first beginnings, the atoms, are indestructible, and into them all things can be dissolved at last. Bodies are partly atoms and partly combinations of atoms; but the atoms nothing can quench. They are strong in solid singieness, and by their denser embination all things can be closely packed and exhibit enduring strength. He denies that mat-ter is infinitely divisible. We come at length the atoms, without which, as an imperishable substratum, all order in the generation and development of things would be destroyed. The mechanical shock of the atoms being in his view the all-sufficient cause of things, he combats the notion that the constitution of nature has been in any way determined by intelligent design. The interaction of the atoms throughout infinite time rendered all manner of combinations possible. Of these the fit ones persisted, while the unfit ones disappeared. Not after save deliberation did the atoms station themselves in their right places, nor did they bargain what motions they should assume. From all eternity they have been driven together, and after trying motions and unions of every kind, they fell at length into the arrangements out of which this system of things has been formed. His grand conception of the atoms falling sliently through immeasurable ranges of space and time suggested the nebular hypothesis to Kant, its first propounder. "If you will apprehend and keep in mind these things, nature, free at once, and rid of her haughty lords, is seen to do all things spontacousty of herself, without the meddling of the gods." During the centuries between the first of these three Philosophers and the last, the human intellect was

ctive in other fields than theirs. The sophists had run through their career. At Athens had appeared the three men, Socrates, Plato, and Aristotle, whose yoke remains to some extent unbroken to the present hour. this period, also, the School of Alexandria was founded; Euclid wrote his "Elements," and he and others made some advance in optics. Archimedes had propounded the theory of the lever and the principles of hydrostatics. Pythagoras had made his experiments on the harmonic intervals while astronomy was immensely enriched by the discoveries of Hipparchus, who was followed by the historically more celebrated Ptolemy Anatomy had been made the basis of scientific medicine, and it is said by Draper* that vivisoction then began. In fact, the science of ancient Greece had already cleared the world of the fantastic images of divinities operating capriciously turough natural phenomena. It had shaken itself free from that fruitless scruting "by the internal light of the mind alone," which had vainly sought to transcend experience and reach a knowledge of ultimate causes. Instead of accidental observation, it had introduced observation with a purpose; instruments were employed to aid the senses; and scientific method was rendered in a great measure complete by the union of induction and experiment.

What, then, stopped its victorious advance! Why was the scientific intellect compelled, like an exhausted to lie fallow for nearly two millennia before it could regather the elements necessary to its fertility and strength? Bacon has already let us know one cause; Wnewell ascribes this stationary period to four causesobscurity of thought, servility, intolerance of disposition, enthusiasm of temper; and he gives striking examples of each.! But these characteristics must have had their causes, which lay in the circumstances of the time. Rome, and the other cities of the Empire, bad fallen into moral putrefaction. Christianity had appeared, offering the Gospel to the poor, and, by moderaagainst the profligacy of the age. early Christians and the extraordinary exaltation of mind which enabled them to triumph over the diabolical tortures to which they were subjected must have left traces not easily effaced. They scorned the earth, in view of that "building of God, that house not made with hands, eternal in the heavens." The Scriptures which ministered to their spiritual needs were also the measure of their science. When, for example, the celebrated question of antipodes came to be discussed, the Bible was with many the ultimate ourt of appeal. Augustine, who flourished A. D. 400, would not deny the rotundity of the earth, but he would deny the possible existence of inhabitants at the other side, "because no such race is recorded in Scripture among the descendants of Adam." Archbishop Boniface was specked at the assumption of a "world of human beings out of the reach of the means of salvation." Thus reined in, science was not likely to make much progress. Later on the political and theo ogical strife between the Church and civil governments. o powerfully depicted by Draper, must have done much to stiffe investigation. Whewell makes many wise and brave remarks regarding the spirit of the Middle Ages. It was a menial spirit. The seekers after natural knowledge had forsaken that fountain of living waters, the direct appeal to nature by observation and experiment, and had given themselves up to the remanipulation of the notions of their predecessors. It was a time when thought had become abject, and when the acceptance of mere authority led, as it always does in science, to intellectual death. Natural events, instead of being traced to physical, were referred to moral causes; while an exercise of the phantasy, almost as degrading as the spiritualism of the present day, took the place of scien-

INFLUENCE OF ARISTOTLE. Then came the mysticism of the Middle Ages, magic, alchemy, the neo-platome philosophy, with its visionary though sublime abstractions, which caused men to look with shame upon their own bodies as hinderances to the absorption of the creature in the blessedness of the Creator. Finally came the scholastic philosophy, fusion, according to Lange, of the least mature notions of Aristotle with the Christianity of the west. Intel lectual immobility was the result. As a traveler with out a compase in a fog may wander long, imagining he is making way, and find himself after hours of toil at his starting point, so the schoolmen, having tied and untied the same knots and formed and dissipated the same clouds, found themselves at the end of centuries in their old position. With regard to the influence wielded by Aristotle in the Middle Ages, and, which, though to a le extent, he still wields, I would ask permission to make one remark. When the human mind has achieved greatness and given evidence of extraordinary power in any domain, there is a tendency to credit it with similar power in all other domains. Thus theologians have found comfort and assurance in the thought that Newton dealt with the question of revelation, forgetful o the fact that the very devotion of his powers, through all the best years of his life, to a totally different class of ideas, not to speak of any natural disqualification tended to render him less instead of more competent to deal with theological and historic questions.

GOETHE AS A SCIENTIST. Goethe, starting from his established greatness as poet, and indeed from his positive discoveries in natural history, produced a profound impression among the painters of Germany when he published his Farbenichre, in which he endeayoured to overthrow Newton's theory of colors. This theory he deemed ac obviously absurd that he considered its author a charlatan, and attacked him with a corresponding vehemence of language. In the domain of patural and we have high authority for assuming that had he devoted himself wholly to that side of science, he might have reached in it an eminence comparable with that which he attained as a poet. In sharpness of observation in the detection of analogies however apparently re mote, in the classification and organization of facts a cording to analogies discerned, Goethe possessed

extraordinary powers. These elements of scientific inquiry fall in with the discipline of the poet. But, on the other hand, a mind thus richly endowed in the direction of natural history may be almost shorn of endowment as regards the more strictly called physical and mechanical sciences. Goethe was in this condition. He could not formulate distinct mechanical conceptions he could not see the force of mechanical reasoning; and in regions where such reasoning reigns supreme he became a mere ignis fatures to those who followed him. I have sometimes permitted myself to compare Aristotle with Goethe, to credit the Stagrite with an almost superhuman power of amassing and systematizing facts, out to consider him fatally defective on that side of the mind in respect to which incompleteness has been just

DEFECTS OF THE STAGISTIE.

Wheweil refers the errors of Aristotle not to a neglect of facts, but to "a neglect of the idea appropriate to the facts; the idea of mechanical cause, which is force, and the substitution of vague or inapplicable notions, involving only relations of space or emotions of wonder." This is doubtless true; but the word "neglect" implies mere intellectual misdirection, whereas in Aristotle, as in Goethe, it was not, I believe, misdirection, but sheer natural incapacity which lay at the root of his mistakes. As a physicist, Aristotle displayed what we should consider some of the worst attitudes of a modern physical investigator-indistinctness of ideas, onfusiou of mind, and a confident use of language, which led to the delusive notion that he had really mastered his subject, while he as yet had failed to grasp even the elements of it. He put words in the place of things, subject in the place of object. He preached induction without practicing it, inverting the true order of inquiry by passing from the general to the particular, instead of from the particular to the general. He made of the universe a closed sphere, in the center of which he fixed the earth, proving from general principles, to his own satisfaction and to that of the world for near 2,000 years, that no other universe was possible. His notions of motion entirely unphysical. It was natural or unnatural, better or worse, calm or violent-no real mechanical ception regarding it lying at the bottom of his mind. He affirmed that a vacuum could not exist, and proved that if it did exist motion in it would be impossible. He de termined à priori how many species of animals must exist, and shows on general principles why animals must have such and such parts. When an eminent cotemporary philosopher, who is far removed from errors of this kind, remembers these abuses of the à pri-ori method, he will be able to make allowance for the jealousy of physicists as to the acceptances of so-called à priori truths. Aristotle's errors of detail were grave and numerous. He affirmed that only in man we had the beating of the heart, that the left side of the body was colder than the right, that men had more teeth than women, and that there is an empty space, not at the front but at the back of every man's head. There is one essential quality in physical conception which was entirely wanting in those of Aristotle and his followers. I wish it could be expressed by a word untainted by its associations; it signifies a capability of being placed as a coherent picture before the mind. The Germans express the act of picturing by the word vorstellen, and the picture they call a Vorstellung. We have no word in English which comes nearer to our require ments than imagination, and, taken with its proper tations, the word answers very well; but, as just intimated, it is tainted by its associations, and therefore objectionable to some minds. Compare, with reference to this capacity of mental presentation, the case of the Aristotelian, who refers the ascent of water in a pump to Nature's abhorrence of a vacuum, with that of Pascal when he proposed to solve the question of atmospheric pressure by the ascent of the Pay de Dome. In the one case the terms of the explanation refuse to fall into place as a physical image; in the other the image is distinct, the fall and rise of the barometer being clearly figured as the balancing of two varying and opposing

ARABIAN ADVANCES IN SCIENCE.

During the drouth of the Middle Ages in Christendom. the Arabian intellect, as forcibly shown by Draper, was active. With the intrusion of the Moors into Spain, cleanliness, order, learning, and refinement took the place of their opposites. When smitten with disease, the Christian peasant resorted to a shrine, the Moorish one to an instructed physician. The Arabs encouraged translations from the Greek philosophers, but not from the Greek poets. They turned in disgust "from the lewdness of our classical mythology, and denounced as an unpardonable plasphemy all connection between the impure Olympian Jove and the Most High God." Draper traces still further than Whewell the Arab elements in our scientific terms, and points out that the under garment of ladies retains to this hour its Arab name. He gives examples of what Arabian men of science accomplished, dwelling particularly on Albazen, who was the first to correct the Platonic notion that rays of light are emitted by the eye. He discovered atmospheric refraction, and points out that we see the sun and moon after they have set. He explains the enlargement of the sun and moon, and the shortening of the vertical horizon. He is aware that the atmosphere decreases in density with increase of hight, and actually fixes its hight at 58; miles. In the Book of the Bal ance Wisdom he sets forth the connection between the weight of the atmosphere and its increasing density. He shows that a body will weigh differently in a rare and a dense atmosphere; he considers the force with which plunged bodies rise through heavier media. He understands the doctrine of the center of gravity, and applies it to the investigation of balances and steelyards. He recognizes gravity as a force though he falls into the error of making it diminish as the distance, and of making it purely terrestrial. He knows the relation between the velocities, spaces, and times of falling bodies, and has distinct ideas of capilary attraction. He improves the hydrometer. The determination of the densities of bodies as given by Alhazen approaches very closely to our own. "I join." says Draper, in the pious prayer of Albazen, "that in the day of judgment the All-Merciful will take pity on the soul of Abur-Rathan, because he was the first of the race of men to construct a table of specific gravities." If all this be historic truth (and I have entire confidence in Dr. Draper), well may he "deplore the systematic manner in which the literature of Europe has contrived to put out of sight our scientific obligations to the Mo

homedans."* COPERNICUS-GIORDANG BRUNO.

Toward the close of the stationary period a wordreariness, if I may so express it, took more and more possession of men's minds. Christendom had become sick of the school philosophy and its verbal wastes, which led to no issue, but left the intellect in everlasting haze. Here and there was heard the voice of one impatiently erying in the wilderness, "Not unto Aristotle, not unto subtle hypotheses, not unto church, Bible, or blind tradition, must we turn for a knowledge of the universe, but to the direct investigation of nature by observation and experiment." In 1543 the epochmaking work of Copernicus on the paths of the heavenly bodies appeared. The total crash of Aristotle's closed universe with the earth at its center followed as a consequence; and "the earth moves" became a kind of watchword among intellectual freemen. Copernicus was canon of the church of Franchburg, in the diocese of Ermeland. For 33 years he had withdrawn himself from the world and devoted himself to the consolidation of his great scheme of the solar system. He made its blocks eternal; and even to those who feared it and desired its overthrow it was so obviously strong that they refrained for a time from meddling with it. In the last year of the life of Copernicus his book appeared; it is said that the old man received a copy of 1 few days before his death, and then departed in peace The Italian philosopher Giordano Bruno was one of th earliest converts to the new astronomy. Taking Lucre tius as his exemplar, he revived the notion of the infinity of worlds; and combining with it the doctrine of Copernicus, reached the sublime generalization that the fixed stars are suns, scattered numberless through space and accompanied by satellites that bear the same relation to them that our earth does to our sun, or our moo to our earth. This was an expansion of transcendent import; but Bruno came closer than this to our present line of thought. Struck with the problem of the gener tion and maintenance of organisms, and duly pondering it, he came to the conclusion that Nature in her produ tions does not imitate the technic of man. Her process is one of unraveling and unfolding. The infinity of forms under which matter appears were not imposed upon it by an external artificer; by its own in trinsic force and virtue it brings these forms forth Matter is not the mere naked, empty capacity which philosophers have pictured her to be, but the universa mother, who brings forth all things as the fruit of her own womb. This outspoken man was originally a Domit can monk. He was accused of hereey and had to fly seeking refuge in Geneva, Paris, England, and Ger nany. In 1892 he fell into the hands of the Inquisition at Venice. He was imprisoned for many years, tried degraded, excommunicated, and handed over to th civil power, with the request that he should be treated gently and "without the shedding of blood." This

meant that he was to be burnt, and burnt accordingly he was, on the 16th of February, 1600. KEPLER-PERE GASSENDI.

To escape a similar fate, Galileo, 33 years afterward, abjured, upon his knees and with his hand upon the holy

Gospels, the nellocentric doctrine. After Gaineo came Kepler, who from his German home defled the power beyond the Alps. He traced out from preëxisting observations the laws of planetary motion. The problem was thus prepared for Newton, who bound those empir ical laws together by the principle of gravitation. Dur-ing the Middle Ages the doctrine of atoms had to all ap-pearance vanished from discussion. In all probability it held its ground among sober-minded and thoughtful men, though neither the Church nor the world was prepared to hear of it with tolerance. Once, in the year 1348, it received distinct expression. But retractation by compulsion immediately followed, and thus discouraged, it slumbered till the seventeenth century, when it was revived by a cotemporary of Hobbes and Descartes, the Père Gassendi. The analytic and synthetic tenden cies of the human mind exhibit themselves throughout history, great writers ranging themselves sometimes on the one side, sometimes on the other. Men of lofty feelings, and minds open to the elevating impressions produced by nature as a whole, whose satisfac tion, therefore, is rather ethical than lorical, have leaned to the synthetic side; while the analytic har monizes best with the more precise and more mechanical bias which seeks the satisfaction of the understanding. Some form of pantheism was usually adopted by the one, while a detached Creator, working more or ess after the manner of men, was often assumed by the other, Gassendi is hardly to be ranked with either. Having formally acknowledged God as the great first cause, he immediately drops the idea, applies the known laws of mechanics to the atoms, and thence deduces all vital phenomena. God, who created earth and water, plants and animals, produced in the first place a definite number of atoms, which constituted the seed of all things. Then began that series of combinations and decompositions which goes on at the present day, and which will continue in the future. The principle of every change resides in matter. In artificial productions the moving principle is different from material worked upon; but in nature the agent works within, being the most active and mobile part of the material itself. Thus this bold ecclesiastic, without incurring the censure of the Church or the world, contrives to outstrip Mr. Darwin. The same cast of mind which caused him to detach the Creator from his universe led him also to detach the soul from the body, though to the body he ascribes an influence so large as to render the soul almost unnecessary. The aberrations of reason were in his view an affair of the material brain. Mental disease is brain disease, but then the immortal reason sits apart, and cannot be touched by the disease. The errors of madness are crrors of the instrument, not of the performer. GASSENDI'S AND MOST RECENT VIEWS.

It may be more than a mere result of education, connecting itself probably with the deeper mental structure of the two men, that the idea of Gassendi, above enunciated, is substantially the same as that expressed by Prof. Clerk Maxwell at the close of the very noble ecture delivered by him at Bradford last year. According to both philosophers, the atoms, if I understand aright, are the prepared materials, the "manufactured articles," which, formed by the skill of the Highest, produce by their subsequent interaction all the nena of the material world. There seems to be this difference, however, between Gassendi and Maxwell. The one postulates, the other infers his first cause. In his manufactured articles, Prof. Maxwell finds the basis of an induction, which enables him to scale philosophic heights considered inaccessible by Kant, and to take the logical step from the atoms to their Maker. The atomic doctrine, in whole or in part, was entertained by Bacon, Descartes, Hobbes, Locke, Newton, Boyle, and their successors, until the chemical law of multiple proportions enabled Dulton to confer spon it an entirely new significance. In our day there are secessions from the theory, but it still stands firm. Only a year or two ago Sir William Thomson, with characteristic penetration, sought to determine the sizes of the atoms, or rather to fix the limits between which their sizes lie; while only last year the discourses of Williamson and Maxwell illustrate the present hold of the doctrine upon the foremost scientific What these atoms, self-moved and self-posited, can and cannot accomplish in relation to life is at the present moment the subject of profound scientific thought. I doubt the legitimacy of Maxwell's logic; but it is impossible not to feel the ethic glow with which his lecture concludes. There is, moreover, a Lucretian grandeur in his description of the steadfastness of the atoms: "Natural causes, as we know, are at work, which tend to modify, if they do not at length destroy, all the arrangements and dimensions of the earth and the whole solar system. But though in the course of ages catastrophes have occurred and may yet occur in the heavens, though ancient systems may be dissolved and new systems evolved out of their ruins, the molecules out of which these systems are built, the foundation stones of the material universe, remain unbroken and

unworn." BISHOP BUTLER'S ANALOGY. Ninety years subsequent to Gassendi the doctrine of oddly instruments, as it may be called, assumed immense importance in the hands of Bishop Butler, who, in his famous "Anniogy of Religion," developed, from his own point of view, and with consummate sagacity, a similar idea. The Bishop still influences superior minds, and it will repay us to dwell for a moment on his views. He draws the sharpest distinction between our real selves and our bodily instruments. He does not, as far as I remember, use the word soul, posbecause the term was so hackneyed in his day, as it had peen for many generations previously. But he speaks of "living powers," "perceiving" or "percipient powers," "moving agents," "ourselves," in the same sense as we should employ the term "soul." He dwells apon the fact that limbs may be removed, and mortal diseases assail the body, while the mind, almost up to the moment of death, remains clear. He refers to sleep and to swoon, where the "living powers" are suspended, but not destroyed. He considers it quite as easy to con ceive of an existence out of our bodies as in them; that we may animate a succession of bodies, the dissolution of all of them having no more tendency to dissoive our real selves or "deprive us of living faculties-the faculties of perception and action-than the dissoin tion of any foreign matter which we are capable of re ceiving impressions from or making use of for the common occasions of life." This is the key of the Bishop's position-"Our organized bodies are no more a part of ourselves than any other matter around us." In proof of this he calls attention to the use of glasses, which prepare objects" for the "percipicut power" exactly as the eye does. The eye itself is no more percipient than the glass, and is quite as much the instrument of the true self and also as foreign to the true self as the glass is. "And if we see with our eyes only in the same manner as we do with glasses, the like may justify be concluded from analogy of all our senses." Lucretius, as you are aware, reached a precisely opposite conciusion; and it certainly would be interesting, if not profitable, to us all to hear what he would or could urge in

opposition to the reasoning of the Bishop. AN IMAGINARY DISCUSSION. As a brief discussion of the point will enable us to se he bearings of an important question, I will here permit a disciple of Lucretius to try the strength of the hop's position, and then allow the Bishop to retailate with the view of rolling back, if he can, the difficulty upon Lucretius. Each shall state his case fully and frankly, and you shall be umpire between them. The argument might proceed in this fashion: "Subjected to the test of mental presentation (Vorstellung), your views, most honored prelate, would present to many minds a great if not an insuperable difficulty. You speak of 'living powers,' 'percipient or perceiving pow ers,' and 'ourselves;' but can you form a mental pic ture of any one of these apart from the organism through which it is supposed to act ! Test yourself honestly, and see whether you possess any faculty that would enable you to form such a conception. The true seif has a local babitation in each of us; thus localized, must it not possess a form ! If so, what form ! Have you ever for a moment realized it! When a leg is amed the body is divided into two parts; is the true self in both of them or in one ! Thomas Aquinas might say in both; but not you, for you appeal to the con-sciousness associated with one of the two parts to prove that the other is foreign matter. Is consciousness, then, a necessary element of the true self ! If so, what do you say to the case of the whole body being deprived of conlousness ! If not, then on what grounds do you deny any portion of the true self to the several limb ! It seems very singular that from the beginning to the end of your admirable book (and no one admires its sober strougth more than I do), you never once mention the brain or nervous system. You begin at one end of the body, and show that its parts may be removed without prejudice to the perceiving power. What if you begin at the other end, and remove, instead of the leg, the brain! The body, as before, is divided into two parts but both are now in the same predicament, and neither can be appealed to to prove that the other is foreign Or, instead of going so far as to remove the

laxations of pressure be applied to the soft substance. At every pressure " the faculties of perception and of action" vanish; at eyery relaxation of pressure they are restored. Where, during the intervals of pressure, is the perceiving power! I once had the dis-charge of a large Leyden battery passed unexpectedly through me; I felt nothing, but was simply blotted out of conscious existence for a sensible interval. Where was my true self during that interval ! Men who have recovered from lightning-stroke have been much longer in the same state; and indeed in cases of ordinary concussion of the brain days may clapse during which no experience is registered in consciousness. Where is the man himself during the period of insensibility ! You may say that I beg the question when I assume the man to have been unconscious, that he was really conscious all the time, and has simply forgotten what had occurred to him. In reply to this, I can only say that no one need shrink from the worst tortures that superstition ever invented if only so felt and so remembered.

LUCRETIUS CITING THE ELECTRIC TELEGRAPH. I do not think your theory of instruments goes at all to the bottom of the matter. A telegraph operator has his instruments, by means of which he converses with the world; our bodies possess a nervous system, which plays a similar part between the perceiving power and external things. Cut the wires of the operator, break his battery, demagnetize his needle; by this means you certainly sever his connection with the world; but, inasmuch as these are real Instruments, their destruction does not touch the man who uses them. The operator survives, and he knows that he survives. What is it, I would ask, in the human system that answers to the onscious survival of the operator when the battery of the brain is so disturbed as to produce insensibility, or when it is destroyed altogether? Another consideration, which you may consider saight, presses upon me with some force. The brain may change from health to disease, and through sheh a change the most exemplary man may be converted into a debanchee or a murderer. My very noble and approved good master had, as you know, tareatenings of lewdness introduced into his brain by his jealous wife's philter; and sooner than permit himself to run even the risk of yielding to these base promptings he slew himself. How could the hand of Lucretius have been thus torned against himself if the real Lucretius remained as before? Can the brain or can it not act in this distempered way without the intervention of the immortal reason? If it can, then it is a prime mover which requires only healthy regulation to render it reasonably self-acting, and there is no apparent need of your immortal reason at all. If it cannot, then the immortal reason, by its mischievous activity in operating upon a broken instrument, must have the credit of committing every imaginable extravagance and crime. I think, if you will allow me to so, that the gravest consequences are likely to flow from your estimate of the body. To regard the brain as you would a staff or an eyeglass-to shut your eyes to all its mystery, to the perfect correlation that reigns between its condition and our consciousness to the fact that a slight excess or defect of blood in it produces that very swoon to which you refer, and that in relation to it our meat and drink and air and exercise have a perfectly transcendental value and significance-to forget all this does, I think, open a way to innumerable errors in our habits of life, and may possibly in some cases initiate and foster that very disease, and consequent mental ruin, which a appreciation of this mysterious organ would have avoided.

BISHOP BUTLER'S REPLY.

I can imagine the Bishop thoughtful after hearing this argument. He was not the man to allow anger to mingle with the consideration of a point of this kind. After due consideration, and having strengthened himself by that honest contemplation of the facts which was habitual with him, and which includes the desire to give even adverse facts their due weight, I can suppose the Bishop to proceed thus: You will remember that in "The Analogy of Religion," of which you have so kindly spoken, I did not profess to prove anything absolutely, and that I over and over again acknowledged and insisted on the smallness of our knowledge, or rather the depth of our ignorance, as regards the whole system of the universe. My object was to show my deisical friends, who set forth so eloquently the beauty and beneficence of Nature and the Ruler thereof, while they had nothing but scorn for the so-called absurdities of the Christian scheme, that they were in no better condition than we were, and that for every difficulty they found upon our side quite as great a difficulty was to be found on theirs. I will now, with your permission, adopt a similar line of argument, You are a Lucretain, and from the combination and separation of atoms deduce all terrestrial things, including organic forms and their nena. Let me tell you in the first instance how far I am prepared to go with you. I admit that you can build crystailine forms out of this play of molecular force, that the diamond, amethyst, and snow-star are traly wonderful structures which are thus produced. I will go further, and acknowledge that even a tree or flower might in this way be organized. Nay, if you can show me an animal without sensation, I will concede to you that it also might be put together by the suitable play of molecular force. Thus far our way is clear, but without sensation, much more are they without intelligence. May I ask you, then, to try your hand upon thus problem ! Take your dead hydrogen atoms, your dead oxygen atoms, your dead carbon atoms, your dead nitrogen atoms, your dead phosphorus atoms, and all the other atoms, dead as grains of shot, of which the brain is formed. Imagine them separate and sensationless; observe them running together and forming all imaginable combinations. This, as a purely mechan ical process, is seeable by the mind. But can you see, or dream, or in any way imagine, how out of that me chanical act, and from these individually dead atoms, ensation, thought, and emotion are to arise f You speak of the difficulty of mental presentation in my case; is it less in yours! I am not all bereft of this Vorstellungs-Kraft of which you speak. I can follow a particle of musk until it reaches the olfactory nerve; I can follow the waves of sound until their tremors reach the water of the labyrinth, and set the otoliths and Corti's fibers in motion; I can also visualize the waves of ether as they cross the eye and hit the retina. THE BISHOP'S VIEW OF RECENT DISCOVERIES.

he motion thus imported at the periphery, and to see in idea the very molecules of the brain thrown into tremors. My insight is not builted by these physical probesses. What baffles me, what I find unimaginable transcending every faculty I possess-transcending, I humbly submit, every faculty you possess-is the notion that out of these pysical tremors you can extract things so utterly incongruous with them as sensation, thought, and emotion. You may say, or think, that this issue of consciousness from the clash of atoms is not more incongruous than the flash of light from the union of oxygen and hydrogen. But I beg to say that it is. For such incongruity as the flash possesses is that which I now force upon your attention. The flash is an affair of con clousness, the objective counterpart of which is a vibration. It is a flush only by your interpretation. You are the cause of the apparent incongruity, and you are the thing that puzzles me. I need not remind you that the great Leibnitz felt the difficulty which I feel, and that to get rid of this monstrous deduction of life from death he displaced your atoms by his monads, which were more or less perfect mirrors of the niverse, and out of the summation and integration of which he supposed all the phenomena of life-sentient, ntellectual, and emotional-to arise. Your difficulty, then, as I see you are ready to admit, is quite as great as mine. You cannot satisfy the human understanding in its demand for logical continuity between molecular processes and the phenomena of consciousness. This is rock on which materialism must inevitably split whenever it pretends to be a complete philosophy of life. What is the moral, my Lucretian ? You and I are not likely to indulge in ill temper in the discussion of these great topics, where we see so much room for honest differences of opinion. But there are people of less wir, or more bigotry (I say it with humility) on both sides, who are ever ready to mingle anger and vituperation with such discussions. There are, for example, writers of note and influence at the pres ent day who are not ashamed to assume the "deer personal sin" of a great logician to be the cause of his unbelief in a theologic dogma. And there are others wno hold that we, who cherish our noble Bible, wrought as it has been into the constitution of our forefather and by inheritance into us, must necessarily be hypo critical and insincere. Let us disavow and discounte nance such people, cherishing the unswerving faith that what is good and true in both our arguments will be preserved for the benefit of humanity, while all that is and or faise will disappear. PROGRESS SINCE THE DAYS OF BISHOP BUTLER.

Nay more, I am abie to follow up to the central organ

It is worth remarking that in one respect the Bishop was a product of his age. Long previous to his day the nature of the soul had been so favorite and general a topic of discussion that when the students of the Uni versity of Paris wished to know the leanings of a new professor, they at once requested him to lecture upon the soul. About the time of Bishop Butler the question was not only agitated, but extended. It was seen by the clear-witted men who entered this arena that man of their best arguments applied equally to brutes and men. The Bishop's arguments were of this character.

He saw it, admitted it, accepted the conse boldly embraced the whole animal world in his of immortality. Bishop Butler accepted with unwaver-ing trust the chronology of the Old Testament, describing it as "confirmed by the natural and civil histor the world, collected from common historians from the state of the earth, and from the late inventions of arts and sciences." These words mark prog-ress; they must seem somewhat hoary to the Bishop's successors of to-day. It is hardly necessary to inform you that since his time the domain of the naturalist has been immensely extended—the whole science geology, with its astounding revelations regarding life of the ancient earth, having been created. ogy, with its astounding revelations regarding the rigidity of old conceptions has been relaxed, the public mind being rendered gradually tolerant of the idea that not for six thousand, nor for sixty thousand, nor for six thousand thousand, but for mons embracing untold mil ions of years this earth has been the theater of life and death. The riddle of the rocks has been read by the geologists and palgontologist, from subcambrian depths to the deposits thickening over the sea-bottoms of to day. And upon the leaves of that stone book are, as you know, stamped the characters, plainer and surer than those formed by the ink of history, which carry the mind back into abysses of past time compared with which the periods which satisfied Bishop Butler cease to have a visual angle.

WHAT THE THEOLOGIANS HAVE CONCEDED.

Everybody now knows this; all men admit it; still when they were first broached these verities of se found loud-tongued denunciators, who preclaimed not only their baselessness considered selentifically, but their immortality considered as questions of ethics and religion. The Book of Genesis had stated the question n a different fashion; and science must necessarily go to pieces when it clashed with this authority. And as the eed of the thistle produces a thistle, and nothing else, so these objectors scatter their germs abroad, and repro duce their kind, ready to play again the part of their ntellectual progemters, to show the same the same ignorance, to achieve for a time the same suc cess, and finally to suffer the same inexorable defeat, Surely the time must come at last when human nature in its entirety, whose legitimate demands it is admitted science alone can satisfy, will find interpreters and expositors of a different stamp from those rash and ill-informed persons who have been hitherto so ready to hurl themselves against every new scientific revelation, lest it should endanger what they are pleased to consider theirs. The lode of discovery once struck, those petri fied forms in which life was at one time active increased to multitudes and demanded classification. The general fact soon became evident that none but the supplest forms of life lie lowest down, that as we climb higher and higher among the superimposed strata more perfect forms appear. The change, however, from form to form was not continuous-but by steps, some small, some great. "A section," says Mr. Huxley, "a hundred feet thick will exhibit at different hights a dozen species of Ammonite, none of which passes beyond its particular zone of limestone or clay into the zone below it or into that above it." In the presence of such facts it was not possible to avoid the question, Have these forms, show ing, though in broken stages and with many irregulari ties, this unmistakable general advance, been subjected to no continuous law of growth or variation! Had our education been purely scientific, or had it been sufficiently detached from influences which, how ever ennobling in another domain, have always hinderances and delusions when intro duced as factors into the domain of physics, the scientific mind never could have swerved from the search for a law of growth, or allowed itself to accept the anthropomorphism which regarded each successive stratum as a kind of mechanic's bench for the manufacture of new species out of all relation to the old. Biassed, however, by their previous education, the great najority of naturalists invoked a special creative act to account for the appearance of each new group of organsms. Doubtless there were numbers who were clear headed enough to see that this was no explanation at all, that in point of fact it was an attempt, by the introduction of a greater difficulty, to account for a less. But having nothing to offer in the way of explanation, they for the most part held their peace. Still the thoughts of reflecting men naturally and necessarily simmered round the question.

EARLY APPROACHES TO DARWINISM.

De Mailiet, a cotemporary of Newton, has been brought into notice by Prof. Huxley as one who "had a notion of the modifiability of living forms." In my frequent conversations with him, the late Sir Benjam Brodie, a man of highly philosophic mind, often drew my attention to the fact that, as early as 1794. Charles Darwin's grandfather was the pioneer of Charles Darwin. In 1801, and in subsequent years, the celebrated Lamarck, who produced so profound an impression on the public mind through the vigorous exposition of his views by the author of the "Vestiges of Creation," endenvored to show the development of species out of changes of habit and external conditions. In 181 Dr. Wells, the founder of our present theory of Dew, read before the Royal Society a paper in which, to use the words of Mr. Darwin, " he distinctly recognizes the principle of natural selection; and this is the first and skill with which Wells pursued his work and the obvious independence of his character rendered him long ago a favorite with me, and it gave me the livellest pleasure to alight upon this additional testimony to his penetration. Prof. Grant, Mr. Patrick Mat thew, von Buch, the author of the "Vestiges," D'Halloy, and others," by the enunciation of views more or less clear and correct, showed that the question had been fermenting long prior to the year 1858, when Mr. Darwin and Mr. Wattace simultaneously, but independently placed their closely concurrent views upon the subject before the Linnean Society. These papers were followed in 1850 by the publication of the first edition of the "Origin of Species." All great things come slowly to the birth. Copernicus, as I informed you, pondered his great work for 33 years. Newton for nearly 16 years kept the idea of gravitation before his mind; for 2 years also he dwelt upon his discovery of fluxions, and loubtless would have continued to make it the object of his private thought had he not found that Leibnitz was upon his track. Darwin for 22 years pondered the problem of the origin of species, and doubtle have continued to do so had he not found Wallace upon his track. A concentrated, but full and powerful epitome of his labors was the consequence. The book was by no means an easy one; and probably not one in every score of those who then attacked it had read its pages through, or were competent to grasp their significance if they had I do not say this merely to discredit them, for there were in those days some really eminent scientific men, entirely raised above the heat of popular prejudice, willing to accept any conclusion that science had to offer, provided it was duly backed by fact and argument, and who entirely mistook Mr. Darwin's views. In fact, the work needed an expounder; and it found one in Mr. Huxley. I know nothing more admirable in the way of scientific exposition than those early articles of his on the origin of species. He swept the curve of dis cussion through the really significant points of the subject, enriched his exposition with profound original remarks and reflections, often summing up in a single pithy sentence an argument which a less compact mind would have spread over pages.

THE LABOR EXPENDED ON DARWIN'S WORKS.

But there is one impression made by the book liself which no exposition of it, however luminous, can con vey; and that is the impression of the vast amount of labor, both of observation and of thought, implied in its production. Let us glance at its principles. It is conceded on all hands that what are called varieties are continually produced. The rule is probably without exception. No chick and no child is in all respects and particulars the counterpart of its brother or sister, and in such differences we have "variety" incipient. No naturalist could tell how far this variation could be car ried; but the great mass of them held that never, by any amount of internal or external change, nor by the mixture of both, could the offspring of the same progen itor so far deviate from each other as to constitute dif-ferent species. The function of the experimental philosopher is to combine the conditions of nature and to proince her results; and this was the method of Darwin.; He made himself acquainted with what could, with out any manner of doubt, be done in the way of producing variation. He associated himself with piganciers-bought, begged, kept, and observed every breed that he could obtain. Though derived from common stock, the diversities of these pigeons were such that "a score of them might be chosen which, if shown to an ornithologist, and he were told that the were wild birds, would certainly be ranked by him as well-defined species." The simple principle which guides the pigeon fancier, as it does the eatile-breeder. is the selection of some variety that strikes his fancy,

The behavior of Mr. Wallace in relation to this signified in the highest degree.

; The first step only toward experimental demonstration taken. Experiments new begun might, a couple of contact termits data of localculable value, which couple to be suspite science of the Interes.

" "History of the Intellectual Development of Europe," p. 295.

brain itself, let a certain portion of its bony covering be removed, and let a rythmic series of pressures and re-